Iron Phthalocyanine Anchored on N-Doped MWCNT/Graphene Oxide nanocomposites as an efficient electrocatalyst for oxygen reduction reaction

Meenakshi Dixit
Anuj Kumar
Nano-Technology Research Laboratory, Department of Chemistry, GLA University, Mathura, Uttar Pradesh 281406, India
Contact@ anuj.kumar@gla.ac.in

Abstract

Iron phthalocyanine (FePc) loaded on nitrogen-doped multi-walled carbon nanotube/graphene oxide (N-MWCNT/GO) nanocomposites was successfully prepared and investigated as an efficient electrocatalyst for the oxygen reduction reaction (ORR). The FePc/N-MWCNT/GO nanocomposite electrocatalyst shows high ORR activity with a positive onset potential, high limiting current density, and high methanol tolerance compared to traditional Pt-based electrocatalysts. The electrochemical double-layer capacitance (CDL) test demonstrated an increased electrochemical surface area, ensuring efficient charge transfer and improved catalytic activity. The successful loading of FePc molecules and the uniform distribution of active sites on the N-MWCNT/GO nanocomposite framework were confirmed by structural and compositional analysis techniques such as X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), elemental color mapping, and transmission electron microscopy (TEM). The synergistic effect of FePc, nitrogen, and the conductive carbon nanocomposite matrix ensures high stability during operational conditions. The results demonstrate the high stability and methanol tolerance of FePc/N-MWCNT/GO nanocomposites as electrocatalysts for next-generation fuel cells.

References

[1] Anuj Kumar*, Shumaila Ibraheem, Tuan Anh Nguyen, Ram K. Gupta, T. Maiyalagan, Ghulam Yasin, Coordination Chemistry Reviews, 2021/9, 214122
[2] Anuj Kumar, Akshay Parmar, Riya Sharma, Shruti Singh, Arunima Nayak, Jasvinder Kaur, Mohd Ubaidullah, Molecular Catalysis, 2025, 115377
[3] Chang-Xin Zhao, Bo-Quan Li, Jia-Ning Liu, Prof. Qiang Zhang, Angewandte Novit Chemie, 2021, 4448-4463
[4] Lingze Wei, Md Delowar Hossain, Gan Chen, Gaurav, A. Kamat, Melissa, E. Kreider, Junjie Chen, Katherine Yan, Zhenan Bao, Michal Bajdich*, Michaela Burke Stevens*, Thomas F. Jaramillo*, Journal of the American Chemical Society, 2024, 13377–13390